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(54) Method and system for routing a paging message from a public land mobile network to a mobile station in a local communication system

(57) Method and system for routing a PAGING message of a mobile terminated call set-up from a public land mobile network (PLMN) to a mobile station (MS) located within a location area (LA) of an office communication system (OS), a mobile switching centre (MSC) communicating with office communication systems via gateways (GW). In order to offer an easy way for routing the PAGING message, the invention proposes the steps of

- forwarding the PAGING message to all gateways (GW) connected to the MSC;

- deleting the PAGING messages in the gateways (GW) of those office communication systems to which the present location area (LA) of the addressed subscriber does not belong;
- exploiting the location area identity information included in the transmitted PAGING message in the gateway (GW), to which the present location area (LA) of the addressed subscriber belongs, for forwarding the PAGING message to the addressed mobile subscriber.

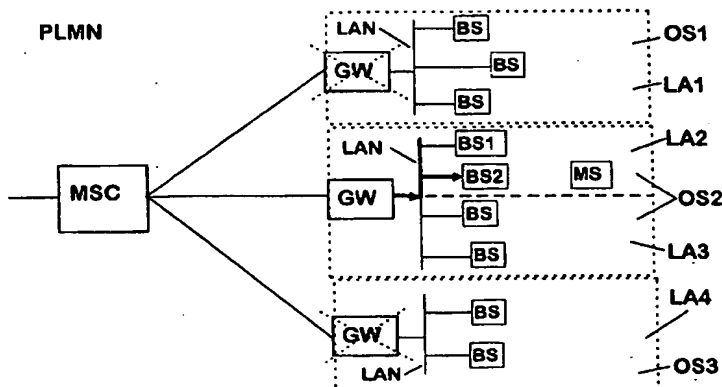


Fig. 2c

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## Description

[0001] The invention relates to a method and a system for routing a PAGING message of a mobile terminated call set-up, including location area identity information specifying the location area, in which the mobile subscriber addressed by the PAGING message is located, from a public land mobile network to a mobile station used by the mobile subscriber located within a location area of an office communication system, the PAGING message being forwarded by a mobile switching centre communicating with at least one office communication system via a gateway, the office communication system comprising a local area network LAN associated with a variety of communication devices, including base stations.

[0002] EP 0 766 427 A2 describes such an office system, an example of which is shown in figure 1. Core of the system is a local area network LAN. Connected to the LAN are several communication devices (6,8,10,12), including low-power base station equipment as represented by the base unit 4, a server 11 and gateway equipment 1. The gateway equipment 1 connects the office communication system to a GSM network. From the point of view of a mobile switching centre MSC of the GSM system, the gateway computer should operate just like a base station controller BSC and it has to carry out the necessary protocol conversions between the GSM protocol and the protocols applied in the local area network. The interface between the gateway computer and the mobile switching centre can be implemented as a DSS.1 + interface.

[0003] The office communication system utilizes cells covering one or a few rooms, implemented mainly indoors. In a local area network using TCP/IP protocols, each base station is assigned a certain electrically defined IP address. A logged in mobile station located in the area of the office communication system continuously assigns itself to the base station of which reception is the best. Therefore, a mobile subscriber using such a mobile station can always be reached behind a specific IP address. When a subscriber is paged from the public land mobile network PLMN, the proper route to the appropriate IP-address needs to be found out.

[0004] The office communication system constitutes at least one location area of a GSM network. The gateway computer monitors mobility inside the office communication system and the databases of a mobile switching centre contain only the knowledge that the terminal is in the area controlled by a certain gateway computer. When a PAGING message addressed to the terminal is coming in, the mobile switching centre directs it to the gateway computer to which belongs the location area in which the addressed mobile subscriber is presently located. The gateway computer then directs the PAGING message to those base units that constitute the location area in which the terminal is situated according to the location database of the gateway com-

puter.

[0005] A disadvantage of the state of the art with regard to the routing of a PAGING message of a mobile terminated call consists in the necessity of making use of a large database assigned to a mobile switching centre in which the present assignment of all mobile subscribers to a location area is stored.

[0006] It is an object of this invention to enable the routing of a PAGING message of a mobile terminated call in an easier way.

[0007] This object is reached through a method according to the preamble comprising the following steps:

- forwarding the PAGING message to all gateways connected to the mobile switching centre;
- deleting the PAGING messages in the gateways of those office communication systems to which the present location area of the addressed subscriber does not belong;
- exploiting the location area identity information included in the transmitted PAGING message in the gateway, to which the present location area of the addressed subscriber belongs, for forwarding the PAGING message to the addressed mobile subscriber.

[0008] The invention proceeds from the idea that a PAGING message is very short. Sending the PAGING message to all connected gateway computers therefore does not much burden the system. On the other hand, large databases for the mobile switching centres with the assignment of all mobile subscribers to a location area are no longer necessary for the routing of a PAGING message.

[0009] In order to be able to decide whether a PAGING message has to be deleted or to be forwarded, each gateway carries out an evaluation of the received location area identity information. Thereby the gateway determines whether the received PAGING message is meant for a mobile subscriber located within a location area of the office communication system to which the gateway belongs, so it can proceed accordingly.

[0010] For carrying out of the method according to the invention in an integrated office communication system, comprising a local area network interconnecting a variety of communication devices of the office communication system, those devices including base stations, each being accessible via an access network entity corresponding to a location area, the local area network LAN being connected with a mobile switching centre of a public land mobile network via a gateway, the invention moreover proposes that the gateway comprises means

- for receiving a PAGING message for a mobile terminated call set-up including location area identity information, containing the information in which

location area the mobile subscriber addressed by the PAGING message is presently located, from the mobile switching centre,

- for evaluating location area identity information and thereby determining if the received PAGING message is meant for a mobile subscriber located within a location area of the office communication system,
- for deleting the PAGING message if the included location area identity information does not refer to one of the location areas within the office communication system, and
- for forwarding PAGING message to the appropriate access network entity, if the included location area identity information refers to one of the location areas within the of the office communication system.

[0011] The invention is explained in more detail with reference to the drawings of which

Fig. 1 shows a communication system according to the state of the art, and  
 Fig. 2a-2d show the routing of a PAGING message to a mobile subscriber.

[0012] Figure 1 has been described above with relation to the state of the art.

[0013] Figures 2a-2d show each a part of a public land mobile network PLMN, e.g. a GSM network, and three office communication systems OS1-OS3. The three office communication systems correspond each in principle to the office communication system of figure 1.

[0014] The depicted part of the GSM network comprises a mobile switching centre MSC connected to the three office communication systems OS1, OS2, OS3. The connections of the GSM network with the different office communication systems OS1, OS2, OS3 are realized by gateway computers GW integrated in each office system.

[0015] Each gateway computer is connected to a local area network LAN providing the means for the internal communication within the office communication system.

[0016] The local area networks LAN interconnect a variety of communication devices in an office communication system OS of which only base stations BS are shown in fig. 2a-d. To each of those communication devices is assigned an IP-address that is unique for the respective office system OS. A mobile subscriber in the office communication system is always located behind a certain IP-address, since to each base station BS, like to any other communication device, is assigned such an IP-address in the local area network LAN and an activated mobile station MS constantly assigns itself to the base station BS of which signals can be received best. The IP-space of each office system is divided into location areas LA which are managed autonomously by access network entities (not shown explicitly). Information including the IP-addresses of the mobile subscri-

ers present in a location area LA is stored in each access network entity. Each office system OS comprises at least one such location area LA; in figures 2a-d, the office systems OS1 and OS3 each comprise one location area LA1 and LA4 respectively and the office system OS2 two location areas LA2 and LA3.

[0017] In the situation shown, a mobile subscriber using a mobile station MS is located in the office communication systems OS1, location area LA1 and the mobile station MS has assigned itself to the base station BS1.

[0018] Fig. 2a-d illustrate the routing of a PAGING message of a mobile terminated call from the GSM network to a mobile station MS located within the boundaries of one of the office communication systems OS2. The route of the message is indicated in each figure by arrows.

[0019] A PAGING message comes in at the mobile switching centre MSC (figure 2a).

[0020] The mobile switching centre MSC does not evaluate any location area identity LAI information included in the PAGING message, but forwards the message to all gateway computers GW of the connected office communication systems OS1, OS2, OS3 (figure 2b).

[0021] Figure 2c shows the next step of the routing of the PAGING message. In the office communication systems OS1, OS2, OS3 the gateway computers GW evaluate whether the incoming PAGING message is meant for a mobile subscriber located in a location area that belongs to the respective office communication system.

[0022] The PAGING message is deleted by those gateway computers GW that are part of the office communication systems OS1, OS3 in the boundaries of which the addressed mobile subscriber is not located presently.

[0023] The gateway computer GW that is part of the office communication system OS2 within the boundaries of which the mobile subscriber is located, exploits the location area identity LAI information included in the PAGING message and determines thereby in which location area LA2/LA3 the mobile subscriber is presently located for further routing of the message.

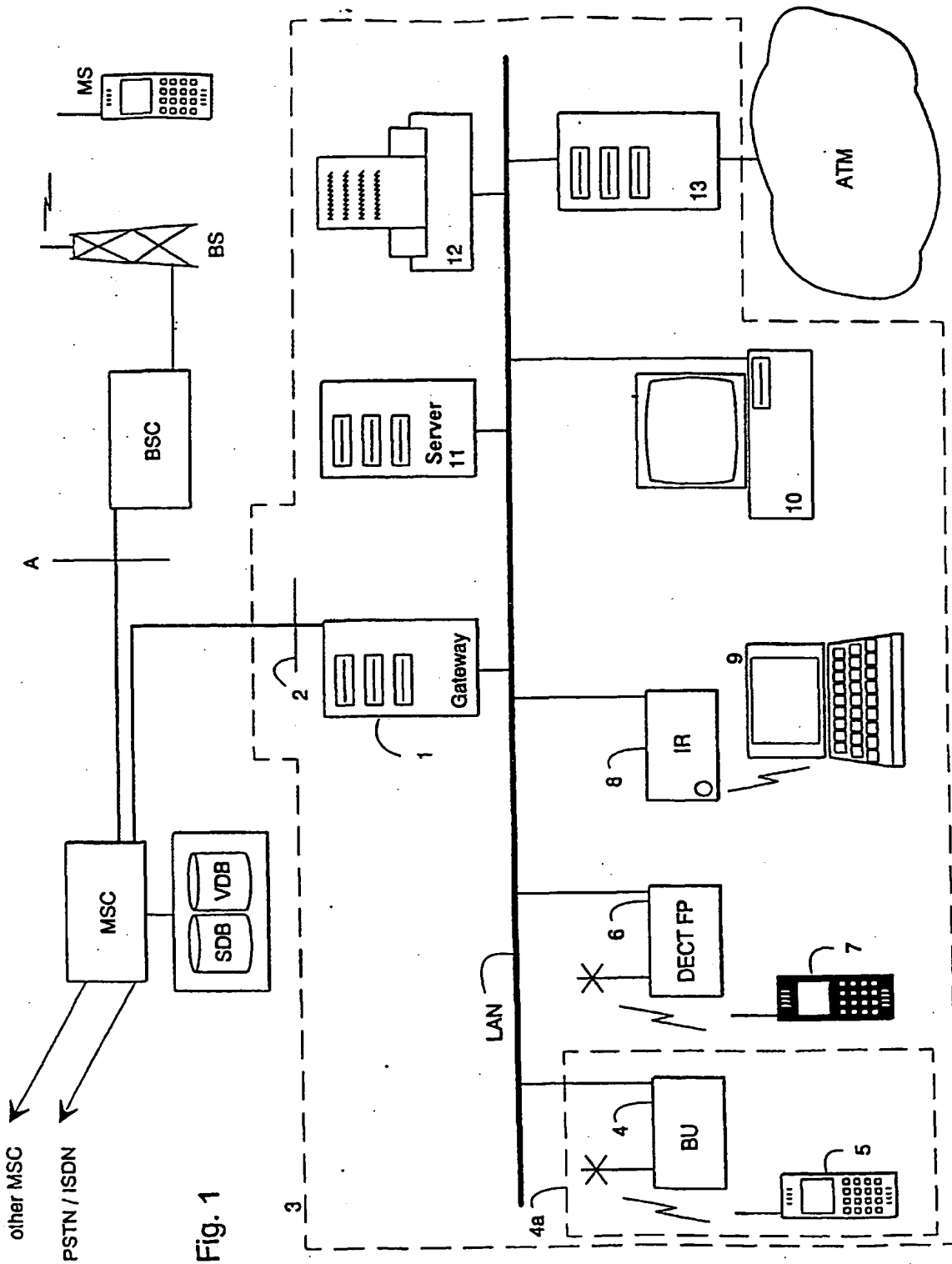
[0024] In the case shown, the office communication system OS2 covers two location areas LA2, LA3. The addressed subscriber is located in location area LA2. Therefore, the gateway computer GW transmits the PAGING message to the access network entity that is responsible for the location area LA2, which then takes care of the further transmission of the message to the base station BS2 according to the locally stored information about the present subscribers and their assigned IP-addresses.

[0025] Finally, the PAGING message is transmitted from the base station BS2, to which the addressed mobile station had assigned itself, by radio interface to the mobile station (figure 2d).

## Claims

1. A method for routing a PAGING message of a mobile terminated call set-up, including location area identity information specifying the location area (LA), in which the mobile subscriber addressed by the PAGING message is located, from a public land mobile network (PLMN) to a mobile station (MS) used by the mobile subscriber located within a location area (LA) of an office communication system (OS), the PAGING message being forwarded by a mobile switching centre (MSC) communicating with at least one office communication system via a gateway (GW), the office communication system comprising a local area network (LAN) associated with a variety of communication devices, including base stations (BS), characterised by the steps of
  - forwarding the PAGING message to all gateways (GW) connected to the mobile switching centre (MSC);
  - deleting the PAGING messages in the gateways (GW) of those office communication systems to which the present location area (LA) of the addressed subscriber does not belong;
  - exploiting the location area identity information included in the transmitted PAGING message in the gateway (GW), to which the present location area (LA) of the addressed subscriber belongs, for forwarding the PAGING message to the addressed mobile subscriber.
2. Integrated office communication system, comprising a local area network LAN interconnecting a variety of communication devices of the office communication system, those devices including base stations, each being accessible via an access network entity corresponding to a location area (LA), the local area network LAN being connected with a mobile switching centre (MSC) of a public land mobile network (PLMN) via a gateway (GW), characterised in that the gateway (GW) comprises means
  - for receiving a PAGING message for a mobile terminated call set-up including location area identity information, containing the information in which location area (LA) the mobile subscriber addressed by the PAGING message is presently located, from the mobile switching centre (MSC),
  - for evaluating location area identity information and thereby determining if the received PAGING message is meant for a mobile subscriber located within a location area (LA) of the office communication system,
  - for deleting the PAGING message if the

included location area identity information does not refer to one of the location areas (LA) within the office communication system, and  
 - for forwarding PAGING message to the appropriate access network entity, if the included location area identity information refers to one of the location areas (LA) within the office communication system.



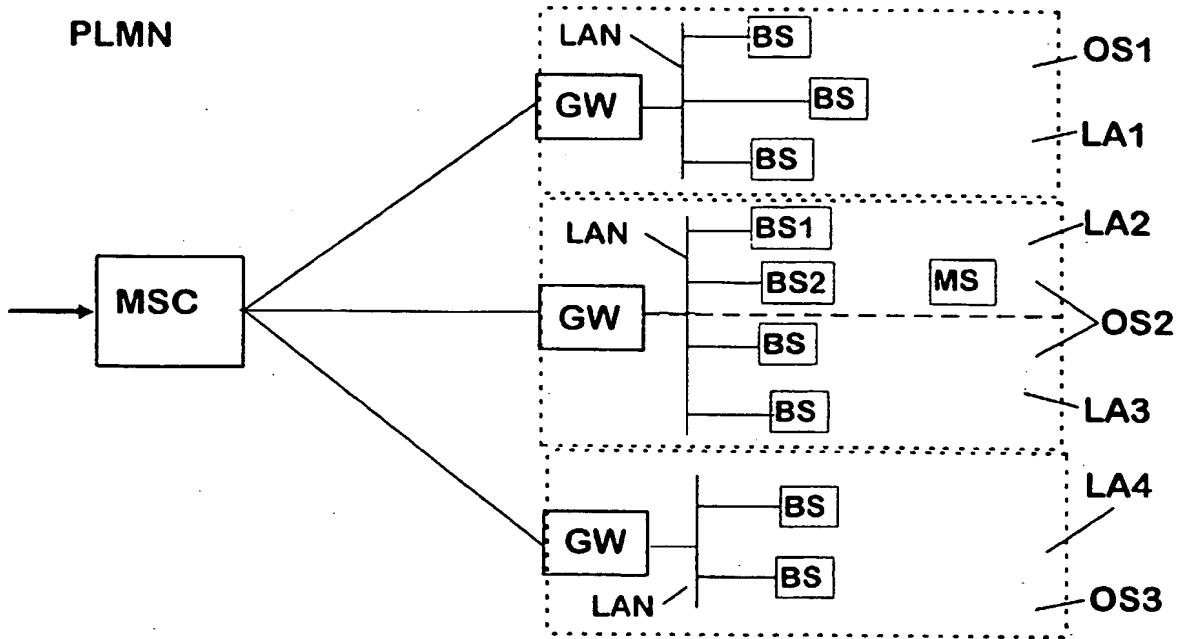


Fig. 2a

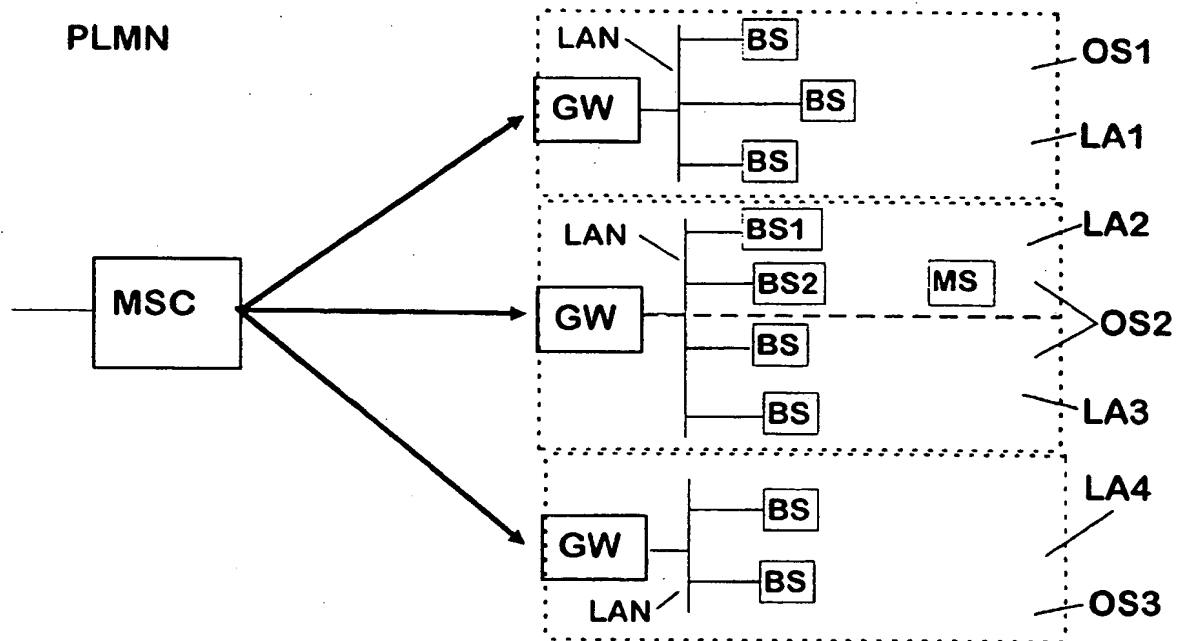


Fig. 2b

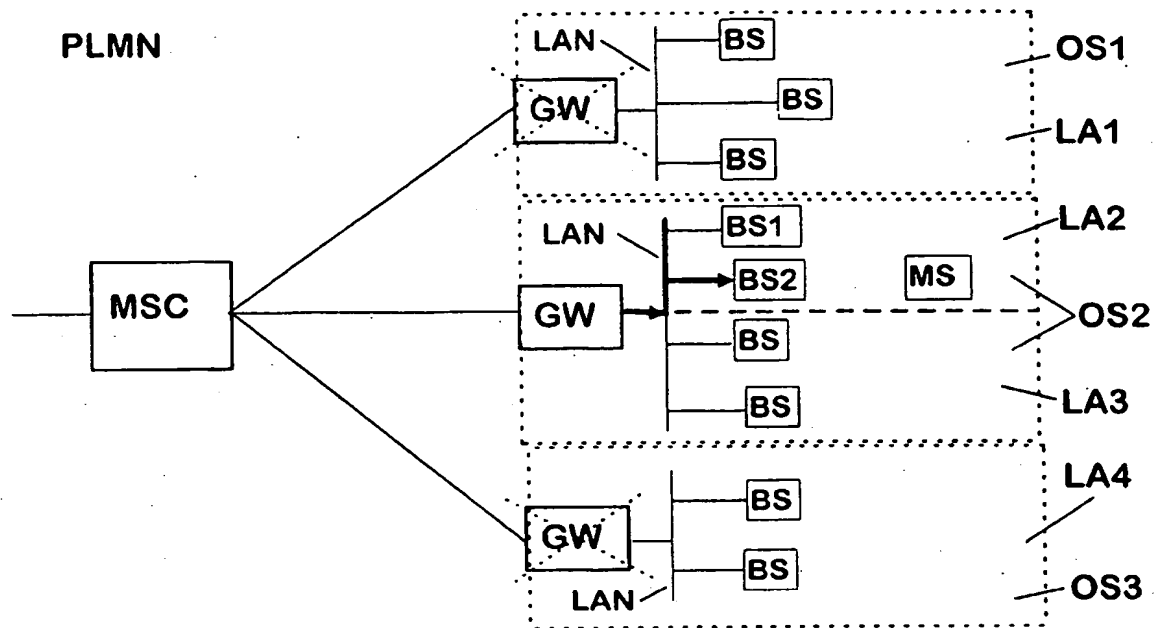


Fig. 2c

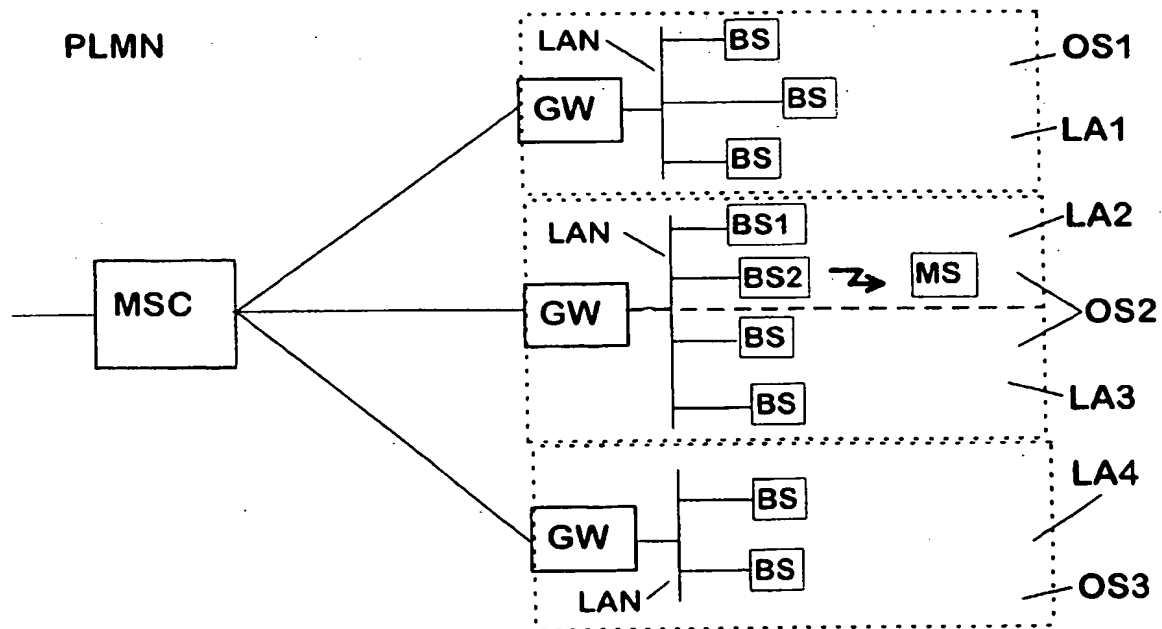


Fig. 2d



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## EUROPEAN SEARCH REPORT

Application Number  
EP 98 10 0657

| DOCUMENTS CONSIDERED TO BE RELEVANT   |   |  |  |
|---|---|--|--|
| Category  | Citation of document with indication, where appropriate, of relevant passages   | Relevant to claim                                | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
| D, Y  | EP 0 766 427 A (NOKIA MOBILE PHONES LTD) 2<br>April 1997<br>* page 4, line 30 - line 49 *<br>* page 8, line 40 - page 9, line 9 *   | 1, 2   | H0407/38<br>H0407/26                         |
| Y   | US 5 305 466 A (TAKETSUGU MASANORI) 19<br>April 1994<br>* column 4, line 35 - line 65 *<br>* column 16, line 7 - column 17, line 51;<br>figures 15-17 *                               | 1, 2   |  |
| Y   | EP 0 558 041 A (NIPPON ELECTRIC CO) 1<br>September 1993<br>* column 4, line 31 - column 6, line 38 *<br>* column 7, line 37 - column 8, line 15 *<br>* column 10, line 17 - line 56 * | 1, 2   |  |
|   |   |  | TECHNICAL FIELDS SEARCHED (Int.Cl.6)         |
|   |   |  | H04Q   |
| The present search report has been drawn up for all claims  |   |  |  |
| Place of search<br>THE HAGUE  |   | Date of completion of the search<br>18 June 1998 | Examiner<br>Baas, G                          |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>&amp; : member of the same patent family, corresponding document</p> |   |  |  |

EPO FORM 1503 03.92 (P4/C01)



**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 10 0657

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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18-06-1998

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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